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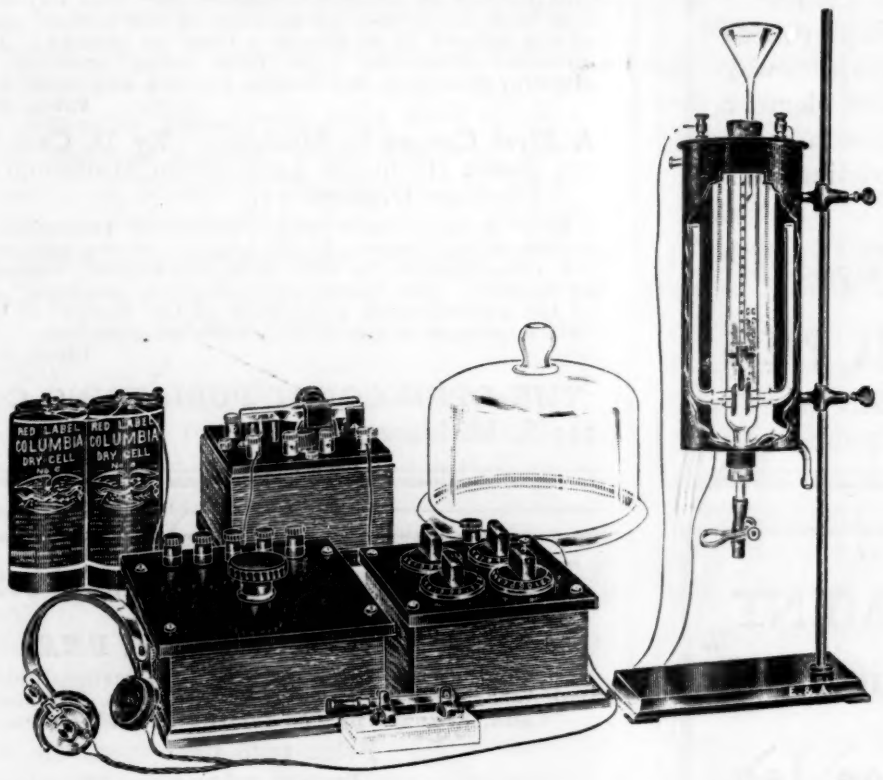

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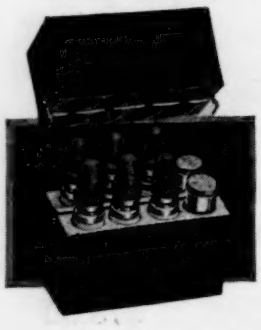

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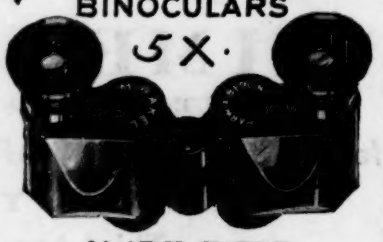

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THE INSTITUTE OF CHEMISTRY ADDRESS OF THE RETIRING PRESIDENT[1]

MY presidential address will be a summary of the work of the outgoing administration and an outline of the program for the future.

The work of my administration has been largely that of perfecting the machinery of organization and of winning recognition for the institute. The indiscretions to be expected from a youthful organization had given an unfavorable impression of the purpose of the institute. The institute has reached adolescence and has demonstrated its sincerity of purpose and high aims.

A code of ethics embodying the principles of professional conduct to govern the profession of chemistry has been formulated and adopted. This code of ethics merits public esteem and justifies confidence in the integrity of the chemist. The institute has established a standard of proficiency of such excellence as to insure competent and efficient service on the part of its members. To safeguard the profession of chemistry, the institute proposes to admit to fellowship only those of proved education, experience, competency and character. The educational requirement consists of a minimum of six years of collegiate and post-graduate training in chemistry or chemical engineering and at least two years of such training must be of an advanced nature. In addition to the six years' training, candidates for fellowship in the institute must have had a minimum of five years' experience and responsibility in the practice of the profession, and must, in addition, meet the requirements imposed by the council for character and American citizenship.

In order to provide means for the improvement of the economic status of the profession of chemistry, the institute has established a register of its membership in which there is a complete record of the training, experience and fitness for service of each individual member. It is not the purpose of the institute to act as an employment agency, but rather as an intelligence office, serving on the one hand the chemist and on the other the public seeking the service of the chemist.

The keynote of the institute is "service," and all its energies are focused on seeing that only those men

[1] Given before the American Institute of Chemists, New York, May 8, 1926.

who are adequately qualified for service in chemistry are designated as chemists, thus safeguarding the public against the quack and shyster chemists who are not only responsible for great economic losses but who are also instrumental in holding down the status of the profession of chemistry and of creating a false impression in the minds of the public as to the work of the chemist.

We have faith in the idea that the reputation of the profession of chemistry can be established by this means better than by any legislative action. We do not believe that genuine service can be guaranteed by legislating to prevent charlatans from pretending to be chemists.

We have provided a means for the appropriate recognition of the distinguished service rendered by individual members of the profession in the form of three medals to be awarded in the fields of governmental institutions, educational institutions and industry.

By "governmental" we mean to include federal and state laboratories and public research laboratories, such as the Rockefeller Institute and Mellon Institute.

Under "educational" we include all research institutions in which the prime aim is pure research. The institute proposes to seek the cooperation of the colleges, universities and technical schools in providing adequate and definite training for the profession of chemistry. While there are many of the schools giving adequate courses of training there are still too large a proportion of men being graduated with inadequate training. There is no differentiation between men who have had only a few courses in elementary chemistry and those who have specialized and done graduate work. We propose to eliminate this condition and try to get recognized the fundamental principle that the profession of chemistry requires certain fundamental training irrespective of specialized departments in which that training is later employed. We also wish to lend our aid in emphasizing the necessity for broad basic training for the profession of chemistry. To this end we propose to suggest that the course shall include sufficient English to enable the chemist to express himself with brevity, clarity, and force, sufficient foreign languages to facilitate keeping in touch with chemical progress in foreign countries, history enough to enable a chemist to understand the conditions of the present and anticipate demands of the future by a comparison of the observations he makes with the record of the past; a basic training in mathematics and physics sufficient to enable the chemist to apply the fundamental principles of chemistry to the solution of engineering problems, sufficient training in the fundamentals of philosophy, psychology, social science and economics to orientate the chemist in his business relationships and to guarantee for him a place in the constructive element of society.

The institute is pledged to a policy of cooperation with all other societies and institutions serving chemistry as a science and as a profession.

M. L. Crossley

Bound Brook, N. J.

THE TRAINING OF MEN FOR THE PROFESSION OF CHEMISTRY[1]

Every one owes some of his time to the upbuilding of the profession to which he belongs.—*Theodore Roosevelt.*

If it lie in my power to make the short address of this evening of any real service to you who hear it, I do not know what I could bring to your attention of greater importance at this time than the need of more attention, on the part of our institute, to some of the present-day problems of chemistry education. We can not as an organization be indifferent to the various interests of our science. Our interests are the universities' interests and also the public interests, and we have a work of our own to do; and being engaged in a labor of science we owe a debt to our educational institutions, and consequently should be prepared to respond to their call for help and advice in their educational work. I feel quite certain that the men who are in active service in the teaching profession and in academic research activities do not disparage to-day the investigations done in industry, and do not put a low value upon industrial work and take a narrow viewpoint of chemical studies carried on successfully outside of the academic atmosphere. We are all working for the accomplishment of a definite object, and the closer we can cooperate in our various problems the more easily and quickly will we achieve the final results for which we all are striving.

After a teaching experience of twenty-five years in an American university which has always played an important part educationally in the promotion and development of the pure and applied sciences, I feel that there is no subject that I am better qualified to speak about to you to-night and which is of more importance to our own profession than that dealing with the problem of training young men for actual service in the field of chemistry. While it is a function of our institute to help in every way that it can the status of the profession of chemistry, we must also ever keep in mind the fact that the first prerequisite for professional success is a thorough fundamental training in those subjects which meet best the needs of

[1] Presidential address delivered before the American Institute of Chemists at their annual meeting held in Rumford Hall in the Chemists' Club, New York City, May 8, 1926.

the chemist. It behooves us as an organization, therefore, to assist our academic teachers in every way that we can in the accomplishment of the difficult educational task which is entrusted to them.

In his presidential address delivered at the third meeting of our institute held in Baltimore, Maryland, in 1925, dealing with the subject, "The American Institute of Chemists, Its Scope and Methods," my predecessor in office wrote as follows:

> This is the formative period in our history. To-day we are concerned chiefly with the formation and development of the machinery of organization. Our future growth will depend upon the structure we create now. This is a very serious undertaking. We can not afford to make many mistakes. Progress is slow at best and we must not be discouraged, if in the face of difficulties and disappointments, we find it necessary to advance cautiously. It is our privilege to serve as members of a very important profession and we are, therefore, obligated to improve the status of this profession. We must establish the means of differentiating between the trained and competent on one hand, and the untrained and incompetent on the other. The public can not differentiate between the qualified chemist and the unqualified, and as a result both are often discredited. It is a function of this institute to say who is a chemist and what constitutes an adequate training for the profession of chemistry.

During the month of September of this year we shall celebrate in the City of Philadelphia the fiftieth anniversary of the organization of the American Chemical Society. In the collection of historical and statistical data which will serve to reveal to the public the progress of this society, I have had the opportunity of making a survey of certain developments which have influenced the growth of this society and which also have an important bearing on the subject which I have chosen for my discussion to-night. Certain facts have been revealed as a result of this research which I believe are of sufficient interest to bring to the attention of this institute. I feel quite confident that the aims and the methods of our organization will be advanced and its function better understood when it is made clear to our academic institutions that we have no selfish purpose, but are interested in aiding them in the solution of some of their present-day educational problems.

In a discussion of the progress of chemistry in this country since the year 1876 it would be impossible to present any survey or a constructive review of what has been accomplished in our field of science without reference to the teaching side, showing the remarkable advance made in educational work and methods. Our institutions of higher learning deserve especial consideration, as they have been the most powerful stimulus to the general activity in science of the entire United States and have been the means of awakening the public mind to the importance of a study of chemical science, giving the same a rank in the general estimate never before attained. We recognize the fact to-day that the acquisition of a knowledge of chemistry and the part it plays in the promotion of human welfare is necessary for the proper rounding out of a cultural education. In fact, on every hand has the educated mind of America been directed toward all departments of scientific study. Chemistry is recognized to-day as a factor of major influence in our everyday life, an agent of power influencing and directing the growth and prosperity of our country.

Preceding the time of organization of the American Chemical Society, there was practically no opportunity offered for American students to acquire a special training in chemistry in American universities. To get an education in this science one was compelled to seek the European university laboratory, and the majority of those who were fortunate enough to enjoy this privilege went to Germany. In fact, if we go back to the year 1853 we find that there were only four laboratories in America that were available at that time for the study of chemistry, namely, the chemistry laboratory at Yale, the Amherst College laboratory, a private laboratory in the city of Philadelphia and the laboratory at the Lawrence Scientific School at Harvard. Professor Chandler writes in one of his lectures that, when he was in Göttingen, Germany, in 1855–6, working in Professor Wöhler's laboratory, thirty students were registered in research in chemistry, of which thirteen were Americans. Even as late as 1876 we maintained no systematic courses of study in chemistry. Students who desired to pursue advanced work in this science were obliged to go abroad. Teaching was chiefly by the didactic method and consequently it is not surprising that little progress was made for several years. It was not a question, however, of there being no great teachers in our country in those early days, as there were several men who stood out very prominently at that time, of whom may be mentioned Elliot, Remsen, Chandler, Morley and Mallet. These distinguished pioneers, who piloted the course of the ship in these early days, are deserving of all the praise and reward that we can give them. The names of any one of them would well grace the rôle of honorary membership in our institute. The majority of the chemists who have attained prominence in their profession can generally point to one of their teachers as the original bearer of the torch which gave him light and inspiration leading to his future success in life. There is no pleasure more gratifying to a teacher for the service that he renders than the experience of living to see some of his students attain success in their profes-

sional career and to feel that he played an important part in their accomplishments. The remark is very often heard to-day that college professors, who used to make most of the discoveries in science, are now being hard run by the scientists in the laboratories of industrial organizations. While this statement is very probably true in some degree, I am not ready to admit that we have reached that stage where our professors must abdicate entirely in favor of their industrial comrades. The greatest accomplishment of all research is the discovery of the young genius who gives promise of developing into an original investigator. In this service we shall always need inspiring teachers and when such men are found in our colleges I have no fear that they will need to abdicate in favor of their industrial brethren.

To-day we have more universities than any other country in the world, we have a larger number of technical schools of the very highest order and innumerable colleges, all of which are offering advanced instruction in the various branches of chemistry. Some of the very finest chemical laboratories and experimental equipment in the world are maintained by these institutions. Every state in the Union has its tax-supported university and agricultural experiment station and their respective laboratories. There is abundant provision for advanced educational work in all the branches of chemistry, and there is every indication that the chemistry staffs in our major institutions realize fully the meaning of the mission they have to perform, in order to turn out the type of product that is expected of them. In other words, we have grown from very small beginnings in fifty years to a position of prominence in the field of chemical education.

These educational institutions are to-day regarded as they have been in the past as the most fitting places for the making of our young investigators in chemistry. Many of them can lay claim to a very high rank in our system of instruction and are contributing in full share to the world's acquisition of new knowledge. This condition did not prevail, however, until in very recent years, when our universities and colleges introduced their modern system of graduate instruction. Formerly we were charged with not contributing our full share year by year, but this could not be justly charged to the teachers operating in those institutions. This condition was due to the fact that those who were competent to do research were unable to do it, because they had no time for it, as they were compelled to devote the major proportion of their time for teaching work or in the performance of administrative duties. This condition was revealed in an emphatic manner in an address delivered at the inaugural exercises of Professor William A. Noyes when he was made head of the chemical laboratory of the University of Illinois on October 18, 1907. He wrote as follows:

> With the older men there are scarcely 20 men in all, directing strictly original research work in our American universities, work involving new ideas, as well as the preparation of new compounds. The supply is far too small to meet the demand, and in view of the importance of the subject, this condition, unless improved, presents a distinct menace to our educational and economic development. A second significant fact is that with the exception of two or three men working under particularly favorable conditions, the productiveness of our research men is by no means commensurate with the output of an equal number of men of Germany. An impartial scrutiny of the situation shows unmistakably serious defects in our American conditions which must be removed if chemical research is to flourish here as abroad, and if able men are to be attracted in sufficient numbers to a life devoted to research and research instruction.
>
> Unless we secure conditions for a large measure of success and productiveness, chemical research in our universities will never attract our best Americans in sufficient numbers to satisfy the minimum demand of our country for able investigators in academic and industrial lines.

Fortunately this condition of affairs has been improved, and it is recognized to-day that no educational institution is worthy of being called a university or a college of high rank which does not provide and encourage the very best opportunity for advanced research. Nowhere in the world has there been such a rapid development educationally in the fields of pure and applied science as in our state universities of the west. There is not one of these progressive institutions to-day which is not doing productive research work in the different branches of chemistry, as well as assisting and contributing to the industrial development of the respective state from which it receives support by taxation. In his paper on "Discovery of Truth in Universities" W. D. Scott[1] has written as follows:

> Archimedes said that if he were only provided with a fulcrum, he could move the earth. The American universities are supplying an effective agency for the discovery of truth, and are thus providing the fulcrum that makes it possible to move the earth and to promote the welfare of all.

As regards originality in the promotion of chemical research and in the application of chemistry to practice we in America hold to-day a most brilliant record. In the early period of our industrial development our record in these respects was given to other countries,

[1] *Century, 108,* N. S. 556 (1924).

who reaped a harvest which should have been ours. It is undoubtedly due in a very large degree to the growth of our modern American graduate schools and the stimulus that has been given to research activities in these institutions that the tables have finally been reversed. To-day just as good opportunities are given in American universities for advanced research in all branches of chemistry as can be found in foreign laboratories. A certification of proficiency in chemistry received from an American university of recognized standing is just as valuable to-day as one received from a foreign university. In our advance we are gaining strength and contributing to the world's knowledge. We find scientists in both our academic and industrial institutions, and in the words of W. H. Perkin, "There is no chasm between pure and applied science, they do not even stand side by side but are linked together."

Great investigators in chemistry, like great men in anything else, are born not made, but when they are born it is necessary that they be trained and the place for their training in chemistry is the university or technical school. Let us as an institute see to it that the officers in charge of the various chemistry departments of these training schools and their teachers are properly instructed and informed of the requirements of our profession.

TREAT B. JOHNSON

YALE UNIVERSITY

SCIENCE FOR HUMANITY'S SAKE[1]

INSTEAD of attempting on this occasion to review research work which is in a limited field, of interest to but few chemists, to whom it is readily accessible, I will endeavor to visualize and depict an ideal, which, like all worthwhile goals, is at times dim and distant, but not the less inspiring.

In "Sermons of a Chemist," that fascinating and stimulating book by Edwin E. Slosson, he has suggested that just as every quadratic equation has two roots, so every question in nature has two parts, "how" and "why" does nature accomplish certain things; and of these questions science is able to answer only the first. If now we inquire regarding the work of the scientist himself, we may properly ask "How does he work?" and "Why does he work?" The annals of science consist chiefly of the answer to the first question, but only occasionally do we find the second question even mentioned, much less discussed. Surely with the greatly increased interest in science during recent decades and the present efforts to further stimulate scientific research, it is not unreasonable to ask: "Why this feverish anxiety to spend money and effort in scientific pursuits?"

In this attempt to point out some of the possible answers to this question, the illustrations will be taken largely from the field of chemistry, because the speaker and the audience are chiefly concerned with that field. It might therefore seem that the title is too comprehensive. In this day and age, however, when the border line between physics and chemistry has ceased to exist and when chemistry plays so important a part in biology and geology, it is safe to assume that much the same factors are involved in the pursuit of chemistry and of the other natural sciences and that the participants are influenced by the same motives.

No doubt the title will at once suggest to you the great service rendered by science to mankind in the prevention and cure of disease and the alleviation of pain; and the industrial chemist may dismiss the subject as having only passing interest for him. For those scientists who have expended their time, means, strength, and even their lives, in the fight against disease, too much praise can not be given. But there is a need also for high ideals and heroic service among those whose work in science deals with more prosaic subjects, such as "shoes and ships and sealing wax." The proverb is as true now as it ever was that "where there is no vision, the people perish."

Some, especially those engaged in "pure science," may resent the suggestion that there need be any reason given for scientific research, and may glibly quote "science for science's sake," or urge that the joy of the work is sufficient justification; or if they fear the appearance of affectation will say that they work just for the fun they get out of it. Beyond a doubt, the joy of discovery is one of the most potent motives of the scientist, and insofar as this attitude stimulates and encourages research in those fundamental fields of science upon which all sound applications must rest, it is indeed commendable. If, however, such an attitude induces indifference toward or even disdain for the application of the results of such researches to meet the needs of humanity, it creates a false distinction and not infrequently cuts off both the moral and the financial support that are essential to the conduct or success of exhaustive and fundamental research. Recognition of this fact is no doubt responsible for the frequency with which those interested and engaged in fundamental studies, which they urge "for science's sake," hasten to assure the public (or Congress) that "besides, one can never be sure but that the most abstract research may lead to results of definite industrial or economic value." If one is to weigh the earth, he feels called upon to explain that the results may aid in the detection of oil-

[1] Address given upon receiving the American Institute of Chemists' Medal in New York, May 8, 1926.

wells. If the structure of the atom is to be investigated, the lure of releasing vast stores of energy or of transmuting the elements is held out as a justification. And this is as it should be. If it were possible to outline any investigation, which by no stretch of the imagination could be of any earthly (or heavenly) service to any one, I doubt whether any scientist would or should feel warranted in undertaking it, much less asking large financial support for it. (If he did, it seems humanly certain that in the back of his head there would be a lurking suspicion or even a hope that he might after all unearth some knowledge of great value to mankind.)

Let us then be frank and admit that the justification for the study of nature, *i.e.*, of science, is its possible "utility." And now you may accuse me of materialism. But let me hasten to say that by utility I mean the "service of humanity." Despite the recent and possibly valid arguments of some psychologists that the human being is one entity, it is still convenient to consider man as made up of body, mind and soul, even though in most cases it may not be possible to differentiate sharply between these phases. Is it then too much to ask that science should contribute alike to the material, the intellectual and the spiritual needs of man?

Our whole modern civilization, with its triumphs and its failures, with its increase in the health and happiness and longevity of civilized peoples, and the horror and destruction of modern warfare, is a literal though complicated record of the application of science, especially of physics and chemistry, to meet the physical and material needs (or desires) of humanity. The "how" of this process, as recorded in the almost innumerable scientific books and journals of the past century, is a record of which scientists may well be proud. And to even attempt to answer the "why" of it would take us too far into the field of sociology and ethics for a mere chemist to follow. No doubt it is asking too much to expect the engineer of an automobile factory to consider whether the car he perfects is to be used by a physician on an errand of mercy or by a burglar on a mission of destruction. But is it expecting too much of him or other scientists to ask occasionally whether the work for which they receive compensation is really contributing to the betterment of humanity, at least in a material sense?

In considering the material benefits of science we must not overlook the return to the scientist himself. At least we may rest assured that "society" is a hard-hearted stepmother and is not prone to reward her children, scientists or others, except as they establish and prosecute a claim for recognition. "Science for science's sake" does not provide food and housing and education for one's family. It is therefore entirely fitting that workers in science should seek for such financial recognition as is necessary for the proper continuation and extension of their service. Here we come into the complicated field of "economics," with which most scientists are less familiar than with "economies," and one would be rash indeed to even suggest the proper division of the profits of industry brought about by the application of science. But at least it is safe to say that any scientist who receives no satisfaction other than his salary, be it large or small, is poor indeed!

It is only within recent years that the value of science in the development of the mind has been appreciated. As a result there are to-day many who believe that one may be truly educated, even though he has not studied Greek and Latin. Again it would take us far afield to discuss the relative cultural value of the sciences and the classics. Possibly some ingenious scientist will solve the dilemma and provide time for both in the already crowded curricula of our colleges, perchance by some manipulation of time in the fourth dimension! At least we must admit that the study of science can and does contribute to the development of the mind and yields intellectual satisfaction that gratifies human longings as real as those for material needs.

The scientist has no right, however, to reserve to himself the intellectual benefits of his work, any more than he has to reap all the material rewards. It is possible through the use and dissemination of science to raise the general intellectual standards of a community. In this connection it is not inopportune to recall the fact that even in this land of liberal education only a minority of the people have a high-school education and a mere sprinkling have had a college course and an opportunity for intensive study of science. Is it then impossible for those without any systematic education in science, who make up not only the laborers, but also most of the foremen and executives in industry, to obtain a grasp and appreciation of science? Experience of the last ten years, to be sure in a limited field, has convinced me that many such men have the interest and capacity to master the essentials of those sciences that are directly applicable in their work. The large enrolment of these men at night schools and in correspondence schools is an evidence of this interest, which no doubt is often stimulated by the inducement of economic advantage through greater technical knowledge. But over and above such gains, many men have expressed the greatly increased satisfaction in their work that arises from a knowledge even though it be superficial, of the underlying scientific principles.

We may well ask whether scientists, *e.g.*, chemists connected with industrial plants, have contributed their fair share toward the encouragement and satisfaction of such an interest on the part of the men

actually engaged in the factory processes. The chemist who throws an air of mystery about his work, who adds secret "dopes" to the solutions in the plants, who embellishes his reports with high-sounding terms, unintelligible to the workman or the superintendent, is simply putting himself in a class with the charlatan and the quack. Perhaps he fears that with a little technical knowledge the foreman can get along without the chemist's service. If he can, so much the better, for there are many other tasks awaiting the application of science. The speaker was once severely criticized by a prominent chemist for teaching electrotypers to titrate the acidity of their copper solutions, with the advice that "if they needed chemistry, they should employ a chemist." But why should a chemist continue to make routine titrations or pH measurements, when the workman or foreman can be taught to do them just as well and can then enjoy his work the more because of this added experience? The best chemist, like the best physician, is the one who teaches his clients how to dispense with his services, and such a one will never lack for other clients.

There is to-day an organized and successful effort for the popularization of science, through the publication of such books as "Creative Chemistry," and "Chemistry in Industry." Pupin, in his fascinating autobiography, expresses his conviction that "every child in the public schools should be made perfectly familiar with the simple experiments which illustrate the fundamental elements of Newton's divine philosophy, as Milton calls science." We are still a long way from the realization of such an ideal in our educational system, but at least science is constantly entering more largely into the common life. That the layman is not afraid of technical terms if he is interested in them is illustrated by the rapid spread of the language of radio.

It is the duty of the scientist to translate, or have translated, the results of his research into terms that can be understood, and if need be, used by the layman. Much of the present interest in science is due to such splendid efforts as those of "Science Service," efforts which have shown that it is not necessary to employ highly specialized language to transmit the essentials of scientific truth. The work of the scientist is only half done when it is published in the annals of his profession; it must also be made available to all those who can use it. The world demands a living science, not a museum!

But even beyond the material benefits and intellectual satisfaction that come from the study and application of science is its elevating effect upon the spirit of man. Paul R. Heyl, in a masterly address to the Washington Academy of Sciences, upon the "Visions and Dreams of a Scientific Man," an address that is itself an epic, has shown that there is a poetry of science that thrills the soul and an appeal to the imagination that is an inspiration to the spiritual life of man. It is almost impossible to touch upon this phase of science without approaching that border line between science and religion that has caused so much needless and useless argument and controversy. If we agree that man's happiness is largely dependent upon his ability to adapt himself to his environment or possibly to adapt his environment to his needs, then all knowledge of science, which Pupin calls "the eternal truth," should contribute to that happiness. To fear the extension of truth is to prefer a bliss of ignorance. The scientist should not forget, however, that his research simply shows "how" God works and leaves unanswered the question which is the concern of religion, *i.e.*, "why" God works. Religion is the science of the soul, a domain in which it has not yet been proven that the laws of physics and chemistry apply.

In recent years the biologists have predicted that through the regulation or addition of "hormones" to the human system, it will be possible to modify the temperament of a person. Whether this prophecy be fulfilled or not, we know that science has already changed the disposition of man; that it has given him a new outlook on life and an inspiration to realize at least in some degree the seemingly limitless possibilities that come through unlocking the mysteries of nature. Even such abstract speculations as those of relativity may give man a more serene confidence in the marvelous coordination of our universe and withal a deep humility.

In the beginning of this talk, some surprise was expressed that scientists so seldom give a reason for their work. But we have seen that in any attempt to answer such a question, we inevitably get into fields of economics, sociology, education, religion and metaphysics; fields in which the specialized scientist may well fear to tread. To overcome this handicap it is necessary that the education of the scientist should be broadened, both during and after his collegiate course. The scientist needs culture, as much as culture needs science.

In recent years we have heard many laments that society does not properly evaluate the work of the scientist, and numerous efforts are being made to impress on the public the importance and service of science. Some writers have suggested that the lack of recognition comes from the fact that scientists have not taken themselves seriously enough. If that has been our fault, we are apparently in a fair way to remedy it! Is the situation not more probably due to the fact that scientists have not taken the rest of the world seriously? We have too often assumed

that science is an end in itself, and have failed to make it a part of the world's work. We have been too often content to be either recluses or cogs in the machinery of industry. We have left too much to others the conduct of the state or even of our own village. We need to work more with others and not simply for others.

In "Arrowsmith," that realistic novel of research in medicine, Sinclair Lewis portrays vividly the obstacles that beset the path of one who hitches his wagon to the star of research. Every worker in science can find in this story his own weaknesses and also those of the benevolent though misguided persons who hinder the progress of truth. But we can not all devote our lives to abstract and fundamental researches. There is a glory and a satisfaction also in lesser service. To me there is a distinct sense of disappointment that in his struggle for the opportunity for pure research, Martin Arrowsmith failed to realize or grasp his opportunities on the way. "It is not alone the goal that counts, but also the path by which we travel."

If anywhere we should expect a high devotion to the ideals of the service of science, it is in the government laboratories, supported by the funds of the people, who naturally and rightly expect some definite returns. In such work there is in addition a need for vision, to prevent the demands for information of immediate value from hindering or entirely interrupting the study of fundamentals, the type of study that has been aptly called "the fountain-head of science." Whether such devotion and such vision are found among your public servants may best be judged by those with better perspective. At least it may be said that the government scientist who is not upheld by an abiding sense of service "is of all men most miserable," for then he has indeed little visible means of support!

The world expects great things of science; it expects science to "give new leases on life, and new tools, and wider visions." The historian may recount the past, but can not change it; the poet may paint the future, but can not bring it to pass; the scientist alone can make his dreams come true. He can not only harness the powers of Niagara, but can at the same time increase its grandeur; he can make the desert and the swamp alike fruitful; he can bring music and poetry through the air to the invalid. He can not only meet the needs of humanity, he can also satisfy desires that science itself has created.

You will recall the story of the visitor who asked several laborers about their work. One said, "I am cutting stone," another "I am carving wood," but a third answered proudly, "I am building a cathedral." If science is as important to humanity as its devotees have been telling the public, then when asked about our work instead of saying, "I am running carbon determinations," "I am synthesizing rubber," or "I am measuring the orbits of the electrons," we should be able to say in all humility, "I am making the world better."

We have seen much of "science for industry's sake"; we have heard much of "science for science's sake"; we need more of "science for humanity's sake."

WILLIAM BLUM

U. S. BUREAU OF STANDARDS

JOHN HOWLAND—1873–1926

DR. HOWLAND died in London, England, on June 20, at the age of fifty-three. Last February, in Baltimore, he had an illness which was regarded as mild encephalitis, but completely recovered. In accordance, therefore, with a plan formed some time previously, he sailed for Europe on March 30 in company with Mrs. Howland and Dr. and Mrs. James Gamble, of Boston. His object was to visit the European clinics, and at the same time to obtain rest and pleasure. He first went to see his brother, Mr. Charles Howland, of New York, who was at the time in Greece, and then traveled on to Budapest, Zurich, Strasbourg, Paris and London. From Paris he wrote that he was entirely well, but Mr. Abraham Flexner reported that he looked pale and thin, and complained of fatigue. On his arrival in London he was taken acutely ill and shortly afterwards had two hemorrhages, apparently of gastric or duodenal origin. An operation was performed on June 15 under the impression that the condition was duodenal ulcer. Death occurred a few days later. Howland had always been in robust health, scarcely ever missed a day's work on account of illness, had always taken excellent care of himself and was free from all habits injurious to health. The news of his death came as a great shock.

Dr. Howland was born in New York City on February 3, 1873. His father, Judge Henry E. Howland, of New York City, a New Englander by birth and descent, was a man of great personal charm, and distinguished for his wit as an after-dinner speaker; he was an extremely well-known figure in the life of the city. Though moving in fashionable circles, Judge Howland retained a freshness and simplicity of character which he handed down to his son. Howland's mother was Sarah Louise Miller, of a well-known New York family. She was an unusually accomplished pianist and gifted with a remarkably clear and vigorous mind. An ancestor was John Howland, of the Mayflower company.

Howland spent his boyhood in New York City and

at the family summer homes in Long Island and Walpole, New Hampshire; studied at the Cutler School in New York City and at King's School, Stamford, and was finally prepared for Yale at Phillips Exeter Academy, graduating in 1890, and entering Yale in the class of 1894. He was said to have been "a hearty, wholesome boy, better than the average, developing slowly and each year a little better than the year previous"; he gave little indication of the important career before him. At Yale he made no effort to distinguish himself as a student, though he graduated in the upper fourth of the class, but did win great distinction as an athlete and in the social life of the college. He was intercollegiate tennis champion, substitute stroke on the university crew, an editor of the college paper and a member of the much sought after society, "Skull and Bones." He was one of the most popular and influential men in his class.

On graduation from Yale Howland was but twenty-one years old and was ranked by tennis experts among the first half dozen players in the country. Most men under the circumstances would have yielded, for a time at least, to the temptation of following tennis as a career. Howland, however, had always, even from boyhood, felt the desire to go into medicine, and realized that success in tennis and success in medicine, such as he would have been satisfied with, were incompatible. On taking up his work in the medical school, with characteristic self-control and obedience to reason, he abandoned tennis absolutely. As throwing light on his qualities of mind and body, he once said to the writer that he could not bear the thought of deteriorating in tennis, preferring, if he could not continue to play in championship form, not to play at all, that he was never conscious, as a match progressed, of the slightest fatigue and in tournament play expected to lose the first two sets, basing his hope of winning on his superior endurance in the concluding three sets. Later, as a means of physical exercise, Howland took up golf, a game in which he had no tradition to support, and in which he soon excelled.

In 1895 the College of Physicians and Surgeons of New York City and the Cornell Medical School took steps to lengthen their required course of study from three to four years. The education in medicine offered by the schools in New York City at that time was exceedingly poor; its value consisted largely in opening the door to the degree of doctor of medicine. The education of practical value began with the hospital interneship. Against the advice of his friends, among whom was Dr. Walter B. James, Howland determined to save a year of study by entering New York University Medical School, which still adhered to the three year curriculum. He relied on the well-known private quiz conducted by Dr. Ellsworth Eliot, to furnish him with the knowledge necessary to obtain an interneship at the competitive examination at Presbyterian Hospital. This feat he successfully accomplished three years later in 1897. On the expiration of his interneship at the Presbyterian Hospital in 1899 he became interne for a year at the New York Foundling Hospital and there came in contact with children and the most progressive and stimulating personality in pediatrics of the time, Dr. L. Emmett Holt. Completing his service at the Foundling Hospital, Howland left for a year's study in Berlin, but soon abandoned Berlin for Vienna, where he took the regular courses in pathology and clinical medicine offered to Americans. On his return to this country in 1901, Howland became the assistant of Dr. Holt and thus definitely embarked on a pediatric career. He rose rapidly to a position of prominence as a practitioner and consultant and became assistant visiting physician to St. Vincent's Hospital, attending physician at the Willard Parker Hospital, pathologist and assistant attending physician to the New York Foundling Hospital and instructor and associate in pediatrics at the College of Physicians and Surgeons. In 1908 he was appointed head of the children's clinic at Bellevue Hospital, which offered the most important children's service at the time in New York City. A lucrative practice and a great reputation as a consultant were assured; a career of great success in the generally accepted definition of that term was visible before him. Such a career, however, was not his ambition. He confided to the writer at that time that what he would like best was a small hospital service and laboratory at Yale which would furnish means of support and opportunity for study and investigation. He little realized how soon and how literally his wish was to be answered, not in New Haven, but in Baltimore.

In 1910 he accepted a call to the reorganized Medical School of Washington University, St. Louis, and in preparation left for Europe for a year's study under the most distinguished pediatrician of the time, Czerny, in Strasbourg. This year of contact with Czerny was most profitable and furnished Howland with the foundation of his ideas in infant feeding and the nutritional disorders of infancy. Returning to America in 1911 he assumed his duties in St. Louis, but remained only one year. In 1912 he accepted a call to succeed Von Pirquet as professor of pediatrics at the Johns Hopkins Medical School and held that important position until the time of his death.

Howland's scientific career began not long after his return from the first period of study in Europe. Following a publication in 1904 of a study of the lesions of dysentery, many papers on a variety of

subjects came from his pen. At first his interests seem to have been mainly clinical and pathological, but soon turned with the current of the time to the chemical aspects of disease. Among his most noteworthy contributions were those on the effects of chloroform poisoning on the liver, the measurement of the chemical and energy metabolism of sleeping children, the acidosis accompanying "intestinal intoxication" and numerous studies on infantile tetany and rickets. His investigations in regard to diarrhoeal acidosis, tetany and rickets represent his most important scientific work. Czerny had advanced the hypothesis that there was an acidosis associated with "intestinal intoxication." Howland and Marriott, applying the conceptions of Lawrence Henderson, proved the existence of an acidosis in intestinal intoxication and showed that it was not an acetone body acidosis. In infantile tetany Howland and Marriott showed that the calcium of the blood was diminished and made the treatment with calcium chloride a routine procedure. Howland's great contribution to rickets, in which Kramer also participated, was the discovery that the disease was characterized by a diminution of the inorganic phosphorus of the blood. Previous investigators had thought of the disease as dependent upon an abnormal metabolism of calcium. The discovery by others that rickets could be produced in rats through varying the calcium and phosphorus in the diet led Howland and Kramer to perceive the principle that the deposition of lime salts in the body is dependent upon a solubility product relationship between the calcium and phosphorus in the circulating fluids. With the writer Howland proved the effectiveness of cod liver oil in rickets. The most recent papers of Howland represent a study of the principles governing lime salt deposition in bones.

Howland was twice accorded the honor of being the lecturer before the Harvey Society of New York City. His last Harvey lecture on the "Etiology and Pathogenesis of Rickets" was a noteworthy contribution to that subject. He was a member of the Board of Scientific Directors of the Rockefeller Foundation for Medical Research, of the Council of Pharmacy and Chemistry of the American Medical Association, a director of the Russell Sage Institute and a member of numerous societies and medical organizations.

As a teacher Howland was exceptionally gifted. He loved teaching and was at his best when employing the Socratic method. He liked to lead the student near pitfalls and was greatly amused if he fell in, and pleased to the same extent if bright enough to escape. There was nothing of the sarcastic or mean in his nature. Information was always to be obtained at his clinics; during the nine years, in which the writer was his assistant, he can never remember attending a single clinic given by Howland in which he did not learn something unknown to him before. Howland was extraordinarily sane as a teacher. He never followed strange gods, and was never carried away from the truth by the bizarre. He preferred to demonstrate several cases in succession, touching only the salient points, rather than to treat a single case exhaustively. He never taught in a systematic manner and he never seemed to have his responsibility as a teacher on his conscience. He was extraordinarily successful as a teacher of his staff by knowing more than they did or by a superiority in his judgments.

As a diagnostician Howland was equalled by but few. A splendid observer, gifted with a most unusual memory and a rich endowment of native shrewdness, he was almost always as close to being correct as was humanly possible. He frequently made brilliant diagnoses, never foolish ones; he took "long shots" when he felt that he could hit the mark, never otherwise. He never suffered from feelings of inferiority which made him leap beyond his premises; he was never afraid to say that he did not know. He did not arrive at a diagnosis by a process of logical ascent—the writer never saw him but once make a careful complete examination of a patient—he seemed to sense the truth.

His relations with patients were marked by unusually great conscientiousness and consideration. No one ever knew him to do anything or to allow anything to be done which might possibly injure a patient. The interest and feelings of obligation excited by ward patients and private patients were the same. In his treatment he was always conservative; he accepted new forms of treatment only after their value and freedom from danger had been proven by others.

As an investigator Howland brought to bear an extraordinary amount of common sense and critical judgment. He almost never worked alone. Others with superior technical knowledge more or less led the way; with his extraordinary judgment of values, however, he knew which problems were worth while; he knew, also, when to begin and when to stop. He was most industrious and himself made the measurements ordinarily left to technicians.

Howland never read a great deal in the years in which the writer was associated with him and rarely worked evenings, but the salient points in his reading were always remembered. He gained a very large part of his great knowledge on a variety of subjects through conversation with those specially informed. He wrote with ease in a style simple and clear. Unlike his father, who spoke in public with great fluency, he spoke with great difficulty and usually wrote out what he intended to say and familiar-

ized himself with it beforehand. He regarded himself as a poor executive and was a poor executive in the sense that he was not methodical. In reality, however, he was a remarkably successful executive in that his ability to choose the right man was so well-nigh perfect and his judgment in regard to things in general so accurate that no direction seemed to be required.

As a man and companion Howland was delightful. He had a great sense of humor and an unusual gift at mimicry. He had known interesting people and had had interesting experiences; he remembered everything. His conversation was full of amusing and interesting anecdotes; his ideas arrested attention. He was a positive character, outspoken in his likes and dislikes and entertained no half way opinions on any subject. At the same time he remained extraordinarily boyish and simple. He was interested in all sorts of sports and contests and could give their histories. He was greatly interested in battles and knew by heart the history of the American Revolution and the Civil War. Life itself as well as diagnosis and investigation were to him games. Though not especially fond of music, he was devoted to Wagner's operas and could recite from the librettos. He was not contemplative, but loved activity out of doors. He was devoted to his family and was never happy when separated from them for any long period. He was a delightful host and had great numbers of friends.

To Howland's own mind the development of his clinic at Johns Hopkins, with all that that development entailed, was his greatest accomplishment. He accepted the call to Johns Hopkins when the salary offered was only $4,000 and the departmental budget proportionately small. The Harriet Lane Home had just been completed and for a long time the number of patients in the wards did not exceed twenty. In the fourteen years of his leadership he saw his clinic grow to be the foremost in the country and the first pediatric clinic, in the true sense of the term, which the country ever possessed. The children in the hospital wards were skillfully cared for; the students splendidly taught; on every side were encountered devotion to duty, enthusiasm for science, the spirit of sacrifice for the ideal; from the wards and laboratories came forth one valuable contribution after another to the science of medicine and from Howland himself went forth one assistant after another to head other departments and to assume positions of responsibility elsewhere, Gamble and Blackfan in Boston, Ross in Montreal, Tisdall in Toronto, Marriott in St. Louis, Casparis in Nashville, Higgins in Cincinnati, Kramer in Brooklyn, Sato in Tohoku, Powers, Shohl and the writer in New Haven. He took the greatest pride in the success of his pupils.

Howland was a leader, not by virtue of any volitional coercive power, but as the result of the superiority of his mind. He was a most remarkable example of extraordinary all-round development. He was one of the four or five great figures in medicine in this country at the present time, and in the history of the Johns Hopkins Medical School should be numbered among its distinguished creators, Halsted, Welch, Osler, Mall, Howell and Abel. His loss to pediatrics, to the country at large and to Johns Hopkins is irreparable.

Dr. Howland is survived by his wife, Susan Morris Sanford, whom he married in New Haven in 1903, and by their four children, Katherine, John, Louise and Elihu; he is also survived by his brother, Charles P. Howland, and his sister, Frances L. Howland, of New York City.

E. A. P.

SCIENTIFIC EVENTS

THE AUSTRALASIAN ASSOCIATION

THE Australasian Association for the Advancement of Science will hold its eighteenth annual meeting in Perth, Western Australia, during the week beginning on August 23. It is stated in *Nature* that Western Australia is making special efforts to secure a good attendance of members from other states and from New Zealand. Private hospitality in Perth during the meeting is being offered to all visiting members. The state government has granted £1,200 towards defraying the cost of printing and publishing, and is giving free transit to visiting members over the W. A. Government Railways, whilst the Australian Commonwealth Government has granted for the Perth meeting the sum of £750, out of which traveling allowances will be made to members coming by the Transcontinental Railway. As the various countries bordering on the Indian Ocean have many scientific problems in common, the Perth local committee has sent invitations to representative scientific men in those countries to attend the meeting, hoping thus to make it an informal Indian Ocean Science Congress, and thereby to inaugurate closer intellectual cooperation amongst the Indian Ocean peoples. To anthropologists, botanists, geologists and zoologists, Western Australia offers features which are unique, even for Australia; and a series of excursions has been arranged to enable visitors to study these as well as the economic resources of the state in mining, agriculture, fruit-growing, forestry, etc.

The retiring president of the association is Lieutenant-General Sir John Monash, whilst the president-elect is Professor Edward H. Rennie, of the University of Adelaide, who has chosen as the title of his

presidential address "The Chemical Exploitation, Past, Present and Future, of Australian Plants." The chairman of the local committee is the Honorable P. Collier, premier of Western Australia. The presidents of sections and the titles of their addresses are as follow: *A* (*Astronomy, Mathematics and Physics*), Professor Kerr Grant, "Atomic Transformation"; *B* (*Chemistry*), Professor James Kenner, "Some Aspects of the Problem of Molecular Structure"; *B* 2 (*Pharmacy*), Mr. A. T. S. Sissons, "The Indebtedness of Pharmacy to Organic Chemistry"; C (*Geology and Mineralogy*), Sir Douglas Mawson, "The Igneous Rocks of South Australia—a brief Survey of Present Knowledge relating thereto"; *D* (*Zoology*), Professor Launcelot Harrison, "The Composition and Origins of the Australian Fauna, with special reference to the Wegener Hypothesis"; *E* (*Geography and History*), Professor Ernest Scott, "The Discoveries of the Western Australian Coast, with especial reference to Dampier and D'Entrecasteaux"; F (*Ethnology and Anthropology*), Professor F. Wood Jones, "The Claims of the Australian Aboriginal"; *G* (*Social and Statistical Science*), Major L. F. Giblin, "Federation and Finance—an Examination of the Financial Relations of States to a Federal Commonwealth"; *H* (*Engineering and Architecture*), Sir John Sulman, "Town Planning"; *I* (*Sanitary Science and Hygiene*), Mr. F. S. Hone; *J* (*Mental Science and Education*), Mr. P. Board, "Social and Economic Values in Education"; *K* (*Agriculture and Forestry*), Mr. C. E. Lane Poole, "Forestry and Land Settlement"; *L* (*Veterinary Science*), Professor J. Douglas Stewart, "The Relationship of Veterinary Science to the Prosperity of the State"; *M* (*Botany*), Professor A. J. Ewart, "Past and Future Development of Botanical Science"; *N* (*Physiology and Experimental Biology*), Professor W. A. Osborne, "The Study of the Reflex." The honorable local secretaries for Western Australia are Mr. A. Gibb Maitland, Geological Survey, Perth, and Professor N. T. M. Wilsmore, University of Perth.

FIELD WORK OF THE VICTORIA MEMORIAL MUSEUM—1926

A considerable amount of field work is done each summer by the Victoria Memorial Museum, which occupies the position of a national Canadian museum. Its field parties are distributed throughout Canada and are engaged chiefly in collecting natural history specimens and records for the museum collections and in scientific investigations of various sorts.

The museum originated seventy-eight years ago in the Geological Survey. It is still closely related with the present institution and its departments of geology, mineralogy and paleontology are maintained by the survey, but in its other departments of anthropology and biology it has attained more nearly to the status of a distinct institution.

During 1926 field work will be done as follows:

Anthropology

D. Jenness will investigate and collect relics from the sites of ancient Eskimo habitations on the Alaskan and Siberian coasts of Bering Sea. Bering Strait has been a route for migration of aboriginal peoples between Asia and America and is a favorable place for the study of these migrations and the spread of Asiatic ethnological influences among the Eskimo of northern Canada. In the course of this work study will be made of modern Eskimo culture and language, particularly for the purpose of augmenting a "Comparative Grammar and Vocabulary of the Western Eskimo Dialects" which Mr. Jenness is compiling.

C. M. Barbeau will continue a study of the social organization, religion and legends of the Tsimshian Indian tribes of Skeena River, upon which he has been engaged for some years. He will also collect information concerning the totem poles of these tribes.

H. I. Smith will continue the work of restoring and preserving totem poles in the Skeena River area. Owing to decline in Indian social organization under the influence of white civilization, these interesting relics are rapidly deteriorating and in danger of complete disappearance. Last year the Canadian National Railways, the Department of Indian Affairs, the Parks Branch, Department of the Interior and the Victoria Memorial Museum took prompt action to preserve the remaining totem poles. In the course of this work Mr. Smith will also study and collect archeological specimens for the museum.

W. J. Wintemberg will excavate ancient Indian village sites and other ruins near Collingwood, in Grey County; near Creemore, Simcoe County; near St. Williams, Norfolk County, and at Lake Medad, Halton County.

Biology

P. A. Taverner will make a zoological survey of the region northwest of Edmonton between the Canadian National and Edmonton Dunvegan and British Columbia railways and will collect specimens for the museum. He will be assisted by Messrs. Hamilton M. Laing and C. G. Harrold. He will also cooperate with Professor William Rowan, of the University of Alberta, in placing identification bands upon gulls at Beaverdell Lake.

C. H. Young will collect specimens of birds, mammals and other animals in the northern part of Cypress hills, Saskatchewan, and from the foothills of the Rocky Mountains in southern Alberta.

R. M. Anderson will make a zoological survey in northern Ontario just north and west of Lake Superior.

M. Q. Malte will conduct a systematic botanical survey of the flora of New Brunswick, particularly in the region of the Bay of Chaleur. A visit will also be made to Prince Edward Island to examine certain species of bent grasses which appear to be suitable for lawns and golf greens.

A. E. Porsild, who is being sent by the Department of the Interior to the country just east of the Mackenzie River delta to investigate conditions for introduction of reindeer, will, through the courtesy of his department, make a botanical survey of this region and collect plants for the National Herbarium.

J. D. Soper, who was sent to Baffin Island in 1924 with the annual Canadian government supply expedition, will continue general biological survey work and collection of specimens until September of this year, when he will return to Ottawa. Mr. Soper intends to travel from Pangnirtung, on Cumberland Sound, which has been his headquarters, through Nettiling and Amadjuak lakes to the coast of Hudson Strait, where he will be picked up by a Hudson Bay Company's steamer.

W. S. Odell, C. Patch and C. Johnson will collect zoological and botanical specimens in the vicinity of Ottawa. Mr. Patch is engaged in collecting material for an illustrated systematic report upon the amphibia and reptilia of Canada.

GEOLOGY AND MINERALOGY

No parties are being sent out expressly for museum purposes, but contributions to the geological and mineral collections will be made incidentally by parties of the Geological Survey.

PALEONTOLOGY

C. M. Sternberg will be sent by the Geological Survey to the Red Deer River Valley near Rumsey, Alberta, to collect fossil remains of dinosaurs and other vertebrate animals. This area is one of the richest repositories in the world and has yielded many fine specimens to Canadian and United States museums.

Other paleontological investigations and collections will be made incidentally by parties of the Geological Survey.

W. H. COLLINS,
Acting Director

WORLD LONGITUDE DETERMINATION

THERE will be a world longitude determination by radio signals, beginning October 1 and ending December 1. This project proposed several years ago has the approval of the International Astronomical Union and of the International Geodetic and Geophysical Union.

The principal stations of the so-called "fundamental polygon" will be at the Naval Operating Base, San Diego, Calif., at the Algiers Observatory and at the Shanghai Observatory. These stations are at nearly the same latitude, and are spaced approximately eight hours apart in longitude. It is proposed to determine the differences of longitude with great accuracy and to make redeterminations at intervals sufficiently separated in time in order to test the permanency of their relative positions and certain possibilities as to movement of the earth's crust.

It is expected that many other observatories will join in this operation, including Washington, Greenwich, Paris and Australasian observatories. The U. S. Coast and Geodetic Survey proposes to occupy stations at Honolulu and Manila.

The radio signals will be of the so-called rhythmic type, so spaced that there will be 61 signals per minute for 5 minutes, 306 in all. They will be sent at three periods of the day, as follows, Greenwich time:

Location	Meters	h m	h m
Annapolis	17,145	20: 10 to	20: 15
		3: 10	3: 15
		10: 10	10: 15
Arlington or Bellevue (near Washington)	74.7 and 24.9	20: 20	20: 25
		3: 20	3: 25
		10: 20	10: 25
Honolulu	11,500	20: 30	20: 35
		3: 30	3: 35
		10: 30	10: 35
Honolulu	36.8	20: 40	20: 45
		3: 40	3: 45
		10: 40	10: 45
Saigon	17,000 and 25	11: 30	11: 35
		19: 00	19: 05
Bordeaux	18,900	8: 01	8: 06
d'Issy (near Paris)	32	20: 01	20: 06
		8: 01	8: 06
		20: 01	20: 06

It is suggested and urged that as many astronomical observatories as can arrange to do so make time observations and receive the signals thus enabling them to establish their longitudes with reference to one or more of these points of reference. The radio signals may be received automatically on a chronograph, a method which has some obvious advantages, or by ear by the coincidence or other methods. Short wave signals are sent as well as long wave signals, as some observers report better reception by the short waves especially at very distant stations, when there is not much daylight between the stations.

The Annapolis and Arlington (or Bellevue) signals will be the principal ones by which observers in this country can connect directly with Washington. These signals will also probably give a direct connection with Greenwich and Paris, as will also the Bordeaux signals.

The International Astronomical Union recommends that in the reductions the star places of the American Ephemeris be used as far as possible and that clock

stars be confined to the region 20° or 25° north and south of the zenith.

Any inquiries regarding the work will be gladly answered by the U. S. Naval Observatory.

A SCHOOL OF MICROSCOPY

THE microscope is being used so generally now-a-days as an aid in many branches of science that a knowledge of its construction, accessories, manipulation and capabilities becomes imperative. The student in high school gets acquainted with it in biology classes, and in colleges it becomes a useful tool in the study of botany, physiology, mineralogy and chemistry.

Medical colleges use the microscope intensively in the demonstration of histology, bacteriology and pathology, and the instrument is indispensable in morphological and cytological research. There are many other fields in which the microscope is employed, besides the pleasure and entertainment afforded those who only enjoy it as a hobby.

The membership of the New York Microscopical Society, one of the affiliated societies of the New York Academy of Sciences, is made up of scientists, students of definite subjects and amateurs, some of whom have never had any regular instruction in microscopical technique and who have neither time nor opportunity to attend college courses to obtain the requisite information.

To meet this need, a School of Microscopy was founded in April of this year by four members of the New York Microscopical Society. Through the courtesy of Bausch & Lomb Optical Co., the free use of their rooms in the Pershing Square Building, Park Avenue and 42nd Street, New York, was granted, together with unlimited cooperation in the use of microscopes of various designs, microtomes, projection apparatus, photomicrographic outfits and all the accessories that are explained and demonstrated before the classes in the school.

Sessions were at first held from 5 to 6:30 on Wednesday afternoon and the first course of ten lessons was successfully given at that hour. To meet the demand for a night class, another group meets at 8 o'clock Wednesday evenings, and the attendance shows this to be the more popular session.

The course at present consists of three demonstrations on the microscope, its design, accessories, manipulation; this instruction is given by John H. Fisher, a physicist residing at Hollis, L. I. Mr. Fisher was formerly with the Bureau of Standards at Washington and is an inventor and expert on fine measurements and accurate measuring instruments.

Phillip O. Gravelle, of South Orange, N. J., known for his work in photomicrography and color photography, has prepared a course of three lectures, in which he uses the latest developments of visual instruction, graphically presenting the methods and results of photography with microscope and camera. Many of his slides were made by utilizing a ribbon filament lamp of his own invention.

For the technical instruction in the preparation of material, use of the microtome, imbedding, staining and mounting permanent slides, the school has enlisted the aid of Dr. Margaret M. Hoskins, member of the Society of Anatomists and of the staff of New York University School of Dentistry. Dr. Hoskins conducts the class through four sessions, including a lecture and demonstration on the study of bacteria and blood with the microscope.

The originator of the project is Charles P. Titus, of East Orange, N. J., former president of the New York Microscopical Society and of the New Jersey Chemical Society. He will act as director of the school, and with E. H. Anthes, assistant manager of the Bausch & Lomb Optical Co., will supervise its activities. A moderate fee is charged for the course, and the proceeds are devoted to the salaries of the instructors and the purchase of supplies and equipment, with the hope that in time a laboratory may be established where students may have the benefit of more extensive personal instruction.

Students may join the classes at any time; letters of inquiry may be directed to the School of Microscopy, Room 1500, Pershing Square Building, New York City.

PROGRAMS IN ENGINEERING AND SOCIAL SCIENCE AT THE PHILADELPHIA MEETING OF THE AMERICAN ASSOCIATION

PAPERS before the engineering section have been arranged as follows:

1. The contribution that has been made by pure science to the advancement of engineering and industry.

Astronomy—DR. FRANK SCHLESINGER, director of Yale University Observatory.

Chemistry—DR. CHARLES H. HERTY, president, Synthetic Organic Chemical Manufacturers' Association.

Economics—DR. JOSEPH H. WILLITTS, head of the department of industry, Wharton School of Finance and Commerce, University of Pennsylvania.

Geology—DR. HEINRICH RIES, professor of general and economic geology, Cornell University.

Mathematics—DR. G. A. BLISS, professor of mathematics, University of Chicago.

Medical Science—DR. RANDLE C. ROSENBERGER, professor of preventive medicine and bacteriology, Jefferson Medical College.

Physics—DR. R. A. MILLIKAN, director of the Norman

Bridge Laboratory of Physics, California Institute of Technology.

Psychology—DR. J. MCKEEN CATTELL, president of the Psychological Corporation, editor of SCIENCE, etc.

2. The stimulation of research in pure science which has resulted from the needs of engineers and of industry.

DR. W. R. WHITNEY, director of the research laboratories of the General Electric Company, Schenectady, N. Y.

Section K, which represents the social and economic sciences in the association, is arranging an important series of papers to be presented at the Philadelphia meeting next December, the general topic being "Law Enforcement." This program is in charge of Dr. Frederick L. Hoffman, dean of the Advanced Department in the Babson Institute, Babson Park, Mass., who is secretary of Section K. About eighteen papers have been arranged for. This should be a very attractive feature of the approaching Philadelphia convention.

BURTON E. LIVINGSTON,
Permanent Secretary

SCIENTIFIC NOTES AND NEWS

DR. ARTHUR A. NOYES, director of the Gates Chemical Laboratory of the California Institute, was elected president of the Pacific Division of the American Association for the Advancement of Science at its recent meeting.

THE HOWARD N. POTTS gold medal of the Franklin Institute will be awarded to Dr. W. D. Coolidge, assistant director of the Research Laboratories of the General Electric Company, at Schenectady, "in consideration of the originality and ingenuity shown in the development of a vacuum tube that has simplified and revolutionized the production of X-rays."

LOUIS A. OLNEY, professor of chemistry and head of the department of textile chemistry and coloring at the Lowell Textile School, received the degree of doctor of science at the commencement of Lehigh University.

WE learn from *Nature* that the list of birthday honors in Great Britain, conferred on July 3, include the following awards in recognition of scientific work: *K.B.E.:* Sir Frank W. Dyson, astronomer royal; Professor W. Somerville, late Sibthorpian professor of rural economy, University of Oxford. *D.B.E.:* Dr. Mary A. D. Scharlieb, consulting gynecologist, Royal Free Hospital. *Knight:* Colonel H. G. Lyons, director and secretary of the Science Museum. *C.B. (Civil Division):* Dr. G. C. Simpson, director of the Meteorological Office; Mr. F. E. Smith, director of Scientific Research, Admiralty. *C.M.G.:* Dr. A. W. Hill, director, Royal Botanic Gardens, Kew; Mr. J. O. Shircore, director of Medical and Sanitary Services, Tanganyika Territory. *C.B.E.:* A. Abbott, chief inspector of technical and continuation schools, Board of Education. *O.B.E.:* E. W. Wallis, secretary of the Royal Sanitary Institute. *I.S.O.:* D. d'E. de Charmoy, assistant director and entomologist, Agricultural Department, Mauritius; A. R. Wright, assistant comptroller, Patent Office.

IT is stated in *Nature* in view of the amount of scientific and other special information now available in periodicals and libraries, an association—The Association of Special Libraries and Information Bureaus—was formed to assist in making such information available to all who wish to use it. With the assistance of the Carnegie United Kingdom Trust the association has undertaken, as one of its first activities, the compilation of a directory of sources of specialized information in Great Britain and Ireland. The general editorship of this work has been entrusted to Mr. G. F. Barwick, formerly keeper of printed books at the British Museum.

SIR HUGH ANDERSON, F.R.S., master of Gonville and Caius College, Cambridge, has been appointed a member of the advisory committee on the administration of the cruelty to animals act, 1867, in the place of Sir John Rose Bradford, F.R.S., who resigned from the committee upon his election as president of the Royal College of Physicians of London.

ENG.-VICE-ADMIRAL SIR ROBERT B. DIXON, engineer-in-chief of the British fleet, has been elected to the presidency of the Junior Institution of Engineers for the year 1926–27 in succession to Mr. J. S. Highfield.

DR. V. CEPINSKIS, professor of physics, has been chosen minister of education in Lithuania.

DR. JOHN W. GOWEN, biologist at the Agricultural Experiment Station, University of Maine, has resigned to become an associate member of the Rockefeller Institute for Medical Research. He will be stationed at Princeton.

JOHN W. LIEB, vice-president and general manager of the New York Edison Company, will preside at the September 6 session of the Basle power conference.

AT the annual meeting of the Manufacturing Chemists' Association held in New York City early last month the following officers were elected: *President,* Henry Howard; *Vice-presidents,* W. D. Huntington and H. A. Galt; *Treasurer,* S. W. Wilder; *Secretary,*

John I. Tierney; *Chairman of the Executive Committee,* A. G. Rosengarten.

AT the annual meeting of the Canadian Institute of Chemistry the following officers were elected: *President,* W. Lash Miller, Toronto; *Secretary,* J. B. Ferguson, Toronto; new *Members of the Council,* M. A. Parke, of Winnipeg; A. L. Kelsall, of Annapolis Royal College, Nova Scotia; R. M. MacLean, Montreal; R. T. Elworthy, of Ottawa, and A. Bruce Macallum, London, Ont.

ANNOUNCEMENT is made by Charles M. Upham, director of the highway research board of the National Research Council, that C. N. Conner, formerly state construction engineer of the North Carolina Highway Commission and more recently chief engineer of the Mexican National Highway Commission, has been designated chairman of the investigation on earth roads being conducted under the auspices of the Highway Research Board.

PROFESSOR REUBEN W. SMITH, professor of wood preservation in the college of forestry of Syracuse University, has resigned to become associated with a New York corporation.

MISS GERALDINE CONNER, of San Francisco, has been appointed secretary of the International Fish Commission called to meet in San Pedro to consider and adjust fishing interests of the United States and Mexico. Miss Conner, who has for several years been chief clerk of the department of commercial fisheries of the California Fish and Game Commission, entered on her new work on July 1. She will have joint charge of the commission's headquarters in San Pedro with Enrique Bernstein, who will represent the Mexican commissioners.

DR. ARTHUR L. DAY is at present engaged in investigations in California as chairman of the advisory committee of the Carnegie Institution of Washington on seismology.

W. C. PARKINSON, of the department of terrestrial magnetism of the Carnegie Institution of Washington, has left for the Huancayo Magnetic Observatory in Peru, where he will act as consultant in the installation of earth-current recording devices.

LIEUTENANT R. R. LUKENS is conducting for the U. S. Coast and Geodetic Survey a resurvey of the New England coast from Cape Cod to Eastport. It will include every locality where there have been changes warranting revision of pilot charts. Inland waterways along the route will be inspected.

L. N. Ericksen, of the staff of the United States Forest Products Laboratory, Madison, Wis., has received a year's furlough to undertake a survey of the lumber requirements of the Western Electric Company of Chicago. The principal aim of the survey will be to determine the suitability of different grades of lumber for various uses in the manufacture of electrical products.

DR. I. E. NEWSOM, professor of veterinary pathology, at the Colorado Agricultural College, Fort Collins, and Dr. J. P. Scott, professor of veterinary science at the Kansas State Agricultural College, Manhattan, are collaborating with Dr. Ivan C. Hall, professor of bacteriology and public health at the University of Colorado Medical School, Denver, in the study of certain anaerobic bacteria responsible for animal infections.

F. E. RAY, who has been principal of the Community High School of Cropsie, Ill., for the past year, has been appointed research assistant at the University of Illinois, to assist Professor Noyes, who retires from active service, but who will continue at the university, doing research work. Mr. Ray holds the degree of bachelor of science from the University of Oxford.

SURGEON GENERAL H. S. CUMMING, head of the United States Public Health Service, has returned from Paris where he has been attending the International Sanitary Conference at which delegates from sixty-three nations were present.

DR. RAY LYMAN WILBUR, president of Stanford University, will be the United States medical delegate to the third Pan-Pacific Science Congress to be held in Tokyo, from October 30 until November 11.

A CABLEGRAM has been received at Harvard University from Dr. Richard P. Strong saying that the Harvard Medical School expedition to study disease in the interior of Africa has arrived at Monrovia, Liberia, and is ready to proceed into practically unexplored territory. Dr. George Shattuck and Dr. Max Theiler, of the medical school, and Dr. Glover M. Allen, of the Boston Society of Natural History, are among those who accompany Dr. Strong. After leaving Liberia the expedition will explore the interior along the Congo River, where a special study of sleeping sickness will be made.

DR. W. R. JILLSON, director and state geologist of Kentucky, has returned from Europe *via* Quebec and Montreal. While abroad he attended the fourteenth International Geological Congress as official representative of the Commonwealth of Kentucky, the Kentucky Geological Survey and the Kentucky Academy of Science. Dr. Jillson was accompanied by Mrs. Jillson in a tour of Europe, during which investigations of petroleum, coal and fluorspar deposits were made.

UNIVERSITY AND EDUCATIONAL NOTES

ON June 30 Armour Institute of Technology at Chicago brought to a successful close a four months' financial campaign for the raising of a million dollars, one third of which was contributed by the Armour family, as a preliminary move in its affiliation with Northwestern University. The next step in the affiliation calls for the raising of a capital fund of $10,000,000 for endowment and buildings to be erected on the Evanston campus of Northwestern University and on the McKinlock campus at Chicago Avenue and the Lake.

HARVARD UNIVERSITY receives $200,000 by the will of the late Charles Downer, a graduate of the college and of the law school. His native town, Sharon, Vt., also became beneficiary to the extent of $100,000. Some years ago Mr. Downer gave the State of Vermont the Downer State Forest, 300 acres, his ancestral home, to be used for experimental and recreational purposes.

BY the death of Mrs. Mae Manford Bridge the contingent bequest of $6,000,000 left by Dr. Norman Bridge to various hospitals and universities is released. By the will of Mrs. Bridge the further sum of $500,000 is left to various institutions.

CHARLES P. HOWLAND, of New York City, who administered the $50,000,000 fund raised by the League of Nations to aid the Greek refugees, has accepted appointment as a trustee of the Johns Hopkins University to assist in carrying out the plan for a new departure in higher education by which Johns Hopkins will devote itself to research and advanced work.

DR. WILLIAM L. MACHMER, instructor in mathematics at the Massachusetts Agricultural College since 1911, has been made dean of the college.

THE following changes in the titles of appointments have been made at the Bussey Institution of Harvard University: William Ernest Castle, professor of genetics, from professor of zoology; Edward Murray East, professor of genetics, from professor of experimental plant morphology; William Morton Wheeler, Ph.D., S.D., professor of entomology, from professor of economic entomology. Dr. Charles Thomas Brues has been promoted to an associate professorship of economic entomology.

ELTON MAYO, formerly professor of psychology in the University of Queenstown and from 1923 to 1925 research associate in industry in the University of Pennsylvania, has been appointed associate professor of industrial research at Harvard University.

DR. ARTHUR L. BLOOMFIELD, of the Johns Hopkins medical faculty, has been appointed professor of medicine in the Stanford Medical School. Dr. Bloomfield fills the vacancy created by the recent death of Dr. A. W. Hewlett, who had held the position since 1916.

DONALD B. KEYES, who has been associated with the U. S. Industrial Alcohol Company for the past eight years serving as director of the research and development department for the past two years, has been appointed professor of industrial chemistry and head of the department at the University of Illinois.

DR. MAJOR GREENWOOD has been appointed professor of epidemiology and vital statistics in the school of hygiene and tropical medicine of the University of London and Dr. W. W. C. Topley, professor of bacteriology in the University of Manchester, has been appointed to the university chair of bacteriology and immunology.

DR. W. E. CURTIS has been appointed professor of physics and director of the physics department at Armstrong College, Newcastle-on-Tyne, in succession to Professor Henry Stroud, who retires at the end of the present session. Dr. Curtis is at present reader in physics in King's College, London.

DISCUSSION

THE REVERSAL OF THE HYDROGEN SERIES IN THE EXTREME ULTRA-VIOLET

IN the course of the presentation of a paper on the spectrum of neon at the spring meeting of the American Physical Society a year ago, I mentioned that I had been able to obtain the first three members of the hydrogen series in the extreme ultra-violet reversed. Recently I have repeated the experiment with the purpose of improving the technique and confirming the results.

In the first place it is necessary to produce a continuous spectrum in the region in question; I have already described briefly how this may be accomplished. (*Astrophysical Journal,* LX, July, 1924, p. 2.) The procedure consists in charging a condenser of about 1/2 micro-farad capacity with a direct current and then discharging it through a vacuum tube of the internal capillary type arranged in series with a half centimeter spark gap. The best results are obtained with a discharge tube of common glass; it is important that the capillary be not too large. I have found a diameter of about a millimeter satisfactory. The material of the electrodes is not important; I have employed tungsten.

The continuous spectrum seems to owe its existence to the disintegration products of the glass set free by the erosive action of the discharge; its strength depends hardly at all on the nature of the gas in the discharge tube. The experiment is not without mechanical difficulties, for the slit of the spectroscope frequently becomes plugged up by glass dust the removal of which involves a troublesome process.

Once the conditions for producing the continuous background have been secured the best results were obtained by admitting hydrogen into the discharge tube at a pressure of about one millimeter. Upon applying the explosive condenser discharge, the first four members of the series; 1215.6; 1025.8; 972.5 and 949.7 appear on the photographic plate sharply reversed. It is not necessary to employ pure hydrogen, however, the first two members of the series have been obtained with helium containing a trace of hydrogen. The nature of the apparatus is such (*Astrophysical Journal,* LX, p. 8, 1924) that a distance of about one centimeter separates the end of the capillary from the slit of the spectroscope while the gas which fills the discharge tube is removed from the light-path by a pump whose inlet lies two centimeters on the grating side of the slit. The path length available for absorption is thus of the order of three centimeters. It seems certain that a very small quantity of hydrogen is sufficient to produce the reversal of the lines.

THEODORE LYMAN

JEFFERSON LABORATORY,
HARVARD UNIVERSITY,
JUNE 29, 1926

THE CLEAVING OF CILIATES BY AMOEBA

MAST and Root[1] and the writer[2] record cases of Amoeba feeding on Paramecium and Frontonia by cleaving the ciliates in half. They express the opinion that Amoeba actually pinches the ciliates into two by means of pseudopodial pressure.

Schaeffer,[3] on the contrary, calls attention to the fact that ciliates not infrequently constrict themselves into two as a result of injuries received when making their way through débris. He regards it as more likely that the ciliates seized by Amoeba also tear themselves into halves when a slight injury is initiated by the mechanical pressure of the pseudopods. Chambers[4] expresses a similar view, stating that the pseudopodial pressure of the amoeba is of little or no importance in the halving of the ciliate. He is led to this conclusion by the observation that slight injuries made in the ectoplasm of Paramecium with a microneedle often result in the ciliate's pinching itself into two.

However, my observations on the cleaving of *Frontonia leucas* by Amoeba do not substantiate the view that the ciliates in all instances tear themselves into halves. In the two cases recorded[2] the frontonia was not pinched into two by the pressure exerted by apposed pseudopods, but was literally stretched into two by the pseudopods of the amoeba. In the process one half of the frontonia was enclosed in a food cup, the free edges of which produced a marked constriction in the middle of the ciliate and constituted a sort of protoplasmic collar around this narrowed region. The pseudopodial collar then streamed toward the free half of the frontonia, actual movement in this direction of the granules of the amoeboid protoplasm being observed. As the streaming progressed, the free half of the ciliate was pressed into the shape of a sphere, and the constricted region connecting the halves became much elongated. When the ciliate was finally stretched into two by this means, the free half assumed its normal shape. In one instance a frontonia was stretched in the process from a length of 0.25 mm to a length of 0.31 mm, as ascertained from camera lucida drawings.

Kepner and Whitlock[5] record a similar case of the stretching of a paramecium to nearly twice its normal length, the pressure exerted by the pseudopodial collar being sufficient to force the free half of the ciliate into a spherical shape. At this stage the amoeba began the ingestion of a specimen of Cyclidium and released the paramecium.

No doubt in some instances ciliates when captured and constricted by Amoeba actually tear themselves into halves. But the complex food reactions described by Kepner and Whitlock and by the writer are not to be accounted for on these grounds. When the cleaving of the ciliate involves a conspicuous elongation of the constricted portion and the compressing of the free half into a spherical shape, and when the actual streaming of the protoplasm in the pseudopodial collar is observed and the stretching of ciliate is demonstrated by measurements, little doubt remains that the ciliate is halved by mechanical pressure of the pseudopods of the amoeba.

C. DALE BEERS

OSBORN ZOOLOGICAL LABORATORY,
YALE UNIVERSITY

[1] Mast, S. O., and Root, F. M., 1916, *Jour. Exp. Zool.,* Vol. 21, pp. 33–49.

[2] Beers, C. D., 1924, *Brit. Jour. Exp. Biol.,* Vol. 1, pp. 335–341.

[3] Schaeffer, A. A., 1926, *Qt. Rev. Biol.,* Vol. 1, pp. 95–118.

[4] Chambers, R., 1924, "General Cytology," Cowdry, pp. 237–309.

[5] Kepner, W. A., and Whitlock, W. C., 1921, *Jour. Exp. Zool.,* Vol. 32, pp. 397–426.

DANGER TO THE CRATER LAKE NATIONAL PARK

I WISH to call the attention of all scientific men, especially botanists, zoologists, ecologists and all lovers and students of nature to the importance of preserving intact the magnificent area of primeval forest that covers much of the southern part of Crater Lake Park in Oregon. The lake itself, one of the two or three greatest scenic localities of the continent, is not the only important feature of the park. The splendid tracts of forest that extend from the high altitudes near the crater rim to the much lower region near the south boundary of the park furnish beautiful examples of several of the types of forest characteristic of the different altitudes in the mountains of the Pacific states. From the scientific and educational point of view as well as from an esthetic one the preservation of this forest is most important. From an economic point of view its destruction is unjustifiable, for it would not stave off the impending end of our timber supply for a single day at the rate we now consume it. Our national park system contains far too much bare rock and barren, scrubbily timbered land, and far too little of the wonderful forests with trees two hundred feet tall or more of which the Pacific states formerly had so much, but which have already been reduced to mere remnants. Our nation does not stand in the slightest need of the paltry sum that will be allowed to dribble into the public treasury from the sale of the Crater Lake Park forests for lumber.

Yet we have every reason to fear and believe that the rumors that high administrative officers of the government have agreed to promote legislation to cut off the southwestern part of the park and place it where its forests will be opened up to the lumbermen are well founded, and that at the next session of Congress this legislation will be slipped through with as little publicity and as little opportunity for any protest as in the case of the laws cutting off valuable parts of other national parks that have passed the present Congress.

WILLARD G. VAN NAME
AMERICAN MUSEUM OF NATURAL HISTORY

A NEW (NINTH) EDITION OF LEE'S "THE MICROTOMIST'S VADEMECUM"

ALL investigators in the biological sciences are indebted to this book for information. The last edition, published in 1921, was edited by Professor J. Brontë Gatenby and largely rewritten by him with the cooperation of Professor W. M. Bayliss, Dr. C. Da Fano, Dr. A. Drew, Dr. W. Cramer and Mr. J. Thornton Carter. It has been so much in demand that a ninth edition is now called for by the publishers, Messrs. P. Blakiston's Son and Company of Philadelphia. In order that adequate and very up-to-date references may be made to the advances in technique which have been made in the United States, Professor Gatenby requests that notes regarding new methods be sent to him directly at the *University Zoological Department, Trinity College, Dublin, Ireland.* He plans to send all proofs to the publishers not later than October 31, 1926.

E. V. COWDRY
THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, NEW YORK

QUOTATIONS

THE PARIS BUREAU OF SCIENTIFIC INFORMATION

THE Office d'Information scientifique et technique of Paris, the initiation of which was noted in our issue for June 12, has favored us with copies of two recent news bulletins, which are interesting to compare with similar issues of the allied Science Service in Washington. The French material has been well selected, and is of real scientific interest; the language is plain and the treatment straightforward, but its somewhat educational tone raises a doubt as to whether the presentation is sufficiently attractive to appeal to editors and readers of the popular press; it may be, however, that the intellectual standard in France is higher than elsewhere. In the United States and England, it is the practice to attract the reader by one or more glaring headlines, to convey the gist of the information (which should contain news) in a short initial paragraph, and then to proceed with details and embellishment. The French procedure, as displayed in these bulletins, is more logical: the headlines are distinctly sober and lacking in "pep"; the article begins with an explanatory or historical preamble, and the news is reserved for a later stage. Although this method will be preferred by the student, it is less effective in attracting the lay reader than the more sensational style of approach.

The "news" element of the bulletins is not strongly represented in the specimens before us, and in a few cases, for example, the articles on telegraphic reception and the nature of X-rays, the explanations given may convey little to the uninitiated. In about one half of the items the information comes from the United States, and the remainder from France; when the service gets better under way one may expect material from other countries to be included. The news appears to have been culled mainly from periodical literature—which must always constitute an important

source—but it is to be hoped that first-hand news obtained from research workers and inventors will later become available; in this respect the American Service has been singularly successful. It is of happy augury that the French organization is starting with high ideals: it will not try to serve both science and mammon; commercial profit is outside its scope and there will be no traffic with the advertiser; and it will preserve a rigid independence of all parties, groups and factions. Its sole aim is the prompt diffusion of scientific and technical knowledge in a way that will neither "mystify the crowd" nor promote sophistry and error by over-indulgence in "purple patches."—*Nature.*

SCIENTIFIC BOOKS

The Music of the Spheres, A Nature Lover's Astronomy, by FLORENCE GRONDAL. New York, The Macmillan Company, 1926. xiii + 234 pages.

IF we were called upon to apologize for the pursuit of pure science, that is of knowledge for its own sake, the diffusion of such knowledge among the masses would be our chief argument. Accordingly, every successful attempt to get the general reader into the path that leads to an acquaintance with the present state of science should be warmly welcomed. A goodly number of such attempts have been made in recent years, particularly in the biological and physical sciences, but many of them have failed either because the man of science has not known how to write or because the writer has not known his science. Notable successes in this field are for the most part the performances of leaders in science who have taken the trouble to learn how to write. But there are some exceptions to this; a very interesting one is presented by the excellent astronomical books of the late Agnes Clerke, who never did any astronomical work herself, but who had the good sense to make use of the cooperation of expert astronomers.

The book before us begins with the most elementary and (to the beginner) the most fascinating phase of the subject, namely, the story of the constellations and the mythology that forms their basis. Intermingled with these stories and following them is an introduction to the present state of astronomy. The author brings to her task a genuine love of the subject and much enthusiasm, and she has a spritely style that makes her text easy reading; but her knowledge of the science is surprisingly deficient. So many and so serious are her misapprehensions that the book defeats its own purpose; the reader who goes on (as the author obviously hopes and expects him to do) to a second and more advanced work will have in his mind ample material for confusion and discouragement. Of those pages that deal with astronomy, as distinct from mythology, there is hardly one that a well-informed critic would leave unchanged in its statement of fact or explanation. From a list that might be made painfully long a few may be cited.

The names of Antares and Capella (page 11), together with those of many other stars, are of Greek and Latin origin, not Arabic. On pages 39, 262 and 301 the spectroscope is credited with feats it has not performed; it did not explode the old idea that stars are fixed (the discovery of proper motions did that at least a century earlier); and it has not proved that the polar caps on Mars are snow or that there is no water on the moon. The Nova in Cassiopeia (page 60) was seen in 1572, not six centuries ago. Surely everyone knows that Bessel had at least something to do with the measurement of the first stellar distance (page 100). By no means is 61 Cygni (page 134) the nearest star as seen from the northern hemisphere nor even the nearest star north of the celestial equator. The period of Delta Cephei (page 140), one of the best known variables in the sky, is more than five days, not four and a half hours. Sirius is not our largest star (page 141) but merely the brightest as seen from the solar system. Six first magnitude stars, in addition to those enumerated (page 145) can be seen from certain points in this country; one of these six is Canopus, a conspicuous object throughout a large part of the country. It is ridiculous to say (page 156) that "about 500 red stars have already been observed but these are all at a distance vastly remote"; the number is much greater and some of them are among our nearest neighbors. Similarly (page 64), the number of known Algol variables is not merely thirty; it exceeds 150. Almost every one knows that Bremen is not in Lower Saxony (page 233). October (page 267) was no more named for a Roman festival than were September, November and December. The brighter moons of Saturn measure thousands of miles in diameter, not hundreds (page 276); and several besides Titan can be seen in small telescopes. The discussion of the age of the earth on page 285 is woefully out of date. The capture of a comet by a stellar system can hardly depend upon the morale of the comet (page 241): "A great comet may be material drawn in from outside space, perhaps flying back and forth between two stars until it becomes so exhausted that one of the stars is able to capture it."

The book is handsomely printed and illustrated; in these respects it does credit to a publishing house whose standards are so well and favorably known. It is a great pity that Mrs. Grondal did not submit her manuscript to a competent astronomer before venturing into print.

FRANK SCHLESINGER
YALE UNIVERSITY OBSERVATORY,
JULY 8, 1926

Die Binnengewässer Mitteleuropas. By AUGUST THIENEMANN. Bd. I, 1925, 255 pp. Published by E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart. Brochure Mk. 16.00, bound Mk. 17.50.

THIS is the first volume of a series of seven which will deal with the physical, chemical and biological features of the inland waters of central Europe; it presents the hydrobiological characteristics of these inland waters and thus serves as an introduction to the six volumes which are to follow.

The book is divided into five sections in which the following types of water are discussed: (a) Underground waters, (b) cold fresh-water springs, (c) flowing waters, (d) standing waters and (e) thermal and brackish waters. The introduction is devoted to a discussion of the nature of limnology. This is followed by fifty-seven pages relating to the first three sections, 138 pages to the fourth and twelve pages to the fifth. More than half of the text, therefore, deals with the various phases of limnology. The ecological features of the different types of aquatic habitats are especially emphasized.

The underground waters are characterized by the absence of light and this affects the green plants adversely but certain forms of algae are able to thrive with minimal amounts of light. The absence of light also affects the animal population, giving rise to a special group of organisms with degenerate eyes. Two other important factors are the relatively low but constant temperature of the water and the scarcity of food.

Spring waters also have a low but constant temperature throughout the year, and they are frequently very deficient in dissolved oxygen. They possess a distinctive fauna which is allied to the blind forms of the underground waters on the one hand and to some forms found in standing waters on the other hand. Several forms found in springs do not attain as large a size as they do in other waters.

The chief factor in flowing water is the current; it affects the variety as well as the shape of the organisms. In the Rhine River, for example, the number of species of fish is greater toward the mouth where the current is slow than toward the source where the current is swift. Also the body form of fishes regularly populating flowing water is different from that of fishes which normally occupy standing water. Some of the inhabitants of swift-flowing streams possess structures for attachment to the substratum so that they will not be swept away by the current.

Lakes, ponds, pools and bogs are considered under the title of standing waters, but the chief part of the section treats of lakes. The temperature, transparency, color and chemistry of lake waters are discussed in some detail. This is followed by a consideration of the different depth regions of lakes in relation to the organisms living therein and of the effect of physical and chemical factors on the vertical and horizontal distribution of these organisms. The different types of lakes are also considered.

The fifth section deals with thermal and brackish waters in relation to their biota.

An excellent bibliography covering twenty pages is given at the end of the book.

C. JUDAY

MADISON, WISCONSIN

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE RING METHOD FOR SURFACE TENSION MEASUREMENT

SOME data which have been published and some more recently obtained in this laboratory by the use of the ring method for determining surface tensions are not entirely in agreement with some of the assumptions which have been made concerning this method. Since many workers consider the ring method to be entirely reliable and recommend it as the only method by which the surface tension of colloidal solutions can be accurately measured, it is of importance to again emphasize the fact that the ring method as it is at present being used is not as reliable as is being assumed.

Cantor[1] has shown that to obtain reliable data the ring should be kept rigid and the force required for detaching the ring from the liquid should be applied on the liquid and not on the ring, and has further shown that the diameter of the wire which is used for making the ring should be so small as to be negligible in comparison with the other dimensions which come into consideration. Sondhaus[2] who first introduced the ring method for surface tension measurements observed that too small a ring must not be used. All the rings which he used were much larger than any which are now used and some were twenty centimeters in diameter. A study of the data which he obtained in measuring the surface tension of distilled water with platinum rings, which were 4.6 and 6.1 centimeters in diameter, shows that the results which were obtained with the larger ring are usually 2 or 3 per cent. higher. Edser[3] has more recently observed that when a ring made of platinum wire which is 0.3 millimeters in diameter is used, the results obtained are about 8 per cent. too high.

A few of the experiments made with the use of a du Nouy tensiometer in measuring the surface tension of water are illustrated in Figure 1. Letting

[1] *Wied. Ann.*, 47 (1892), 399.

[2] *Ann. der Physik. Chem.*, 8 (1878), 266.

[3] Fourth Report on Colloidal Chemistry (Brit. Assn. Adv. Sci.) (1922), 284.

$p = \frac{F}{4\pi r}$, when F is equal to the number of dynes necessary to bring about detachment, r the radius of the wire and R the radius of the ring, it was found that as r varied from 0.0160 to 0.0405 centimeters, the value of p varied more than nine dynes and that it varied more than sixteen dynes as the value of $4\pi R$ varied from 4,120 to 11,808 centimeters. The technique introduced by Klopsteg,[4] though obviously correct, does not eliminate these variations, and corrections according to the correction factors of Cantor or MacDougall[5] are negligible in comparison. Variations in the case of benzene were quite as regular but not nearly as great.

McDougall[5] found that p diminishes as r increases. In the present experiments it is to be observed that p increases as either r or R increases. The data obtained with the ring supplied with the instrument apparently lie in that part of the curves where a change in the value of r or R produces an almost maximum effect. The writer can not offer a correction factor for obtaining correct surface tension values for the data obtained by the ring method, nor is it possible to review all the deductions given by Cantor and MacDougall for the ring method and of Lohnstein[6] and Lenard[7] for similar methods. Aside from any mathematical deduction, it is evident that the approximately correct values obtained for the surface tension of water with the ring supplied with the instrument are the result of the cancellation of equal and opposite errors. Values obtained for benzene with the same ring are too high.

It is claimed that only the ring method will give absolute values for the surface tension of colloidal solutions. Since the surface tension of many colloidal solutions changes with time and does not readily reach an equilibrium value, no method can be used for obtaining absolute values in the case of such solutions. In previous papers[8] it was shown by three methods, one of which was the ring method, that the surface tension of colloidal solutions changes with time according to the equation $\sigma = a/t^n$. Until more is known of the conditions under which the constant n changes it will be difficult to draw comparisons relative to definite periods of time and still more difficult to compare approximate conditions of equilibrium. Two hours can not be assumed as sufficient for reaching a state of even approximate equilibrium. Frequently the change following an initial period of two hours is several times as great as it was in this initial period. Some of the data given as typical for the ring method indicate that the change during a second period of two hours is nearly equal to that of the second half of the initial two hour period. It is therefore futile to try to obtain absolute surface tension values for many colloidal solutions. A definite time period should not be indiscriminately chosen as one in which even an approximate equilibrium point will be reached and the utmost discrimination must be exercised in comparing data which are relative to definite periods of time.

J. M. JOHLIN

SCHOOL OF MEDICINE,
VANDERBILT UNIVERSITY

4 SCIENCE, 60 (1924), 319.
5 SCIENCE, 62 (1925), 290.
6 *Ziet. Physik. Chem.*, 10 (1892), 504.
7 *Ann. Physik.*, 13 (1924), 385.
8 *Jour. Phys. Chem.*, 29 (1925), 1137.

SPECIAL ARTICLES

BUTTERMILK AS A FERTILIZER FOR BLUEBERRIES[1]

IN casting about for acid, organic, nitrogenous fertilizers for blueberries and other acid-soil plants, I long ago considered buttermilk as one of the materials with which to experiment. My attention was again called to the subject last year by Herman E. Gasch, a Washington lawyer, farmer and man of understanding, who showed me a newly planted and thriving holly tree and told me, among other things, that he had given it a liberal application of buttermilk.

Plants in suitable condition for a buttermilk experiment became available in May of this year. They were blueberry seedlings that had been potted in January, 1926, in two-inch porous earthenware pots, in the standard soil mixture for the greenhouse culture of blueberries, rhododendrons and azaleas, two parts of upland peat and one part of sand. After about four months in a greenhouse maintained at a temperature of 55° Fahrenheit at night and 70° in the daytime, the growth of the plants had begun to slacken, as is normal under these conditions.

On May 14 a teaspoonful (about 5 cc) of buttermilk was applied to each of sixteen of these plants. Each pot contained about 50 cc of soil. These pots were plunged in sand in a flat containing thirty-nine other exactly similar, but untreated, plants.

Within ten days the leaves of the plants to which the buttermilk had been given had taken on a darker green color than those of the untreated plants. In two weeks the buttermilk plants were in active growth, some of them putting out new strong basal shoots, some branching from the upper axils, some pushing

1 This early announcement of greenhouse experiments will, it is hoped, enable others to make similar fertilizer experiments out of doors with buttermilk or other by-products of milk, on blueberries, rhododendrons, azaleas, and other acid-soil plants during the present season.

from a dormant bud, preparatory to a burst of new growth.

At the end of four weeks the plants fertilized with buttermilk were in the relative condition shown in Figure 1. They were 37 per cent. taller than the untreated ones, averaging 6.6 inches as contrasted with 4.8 inches.

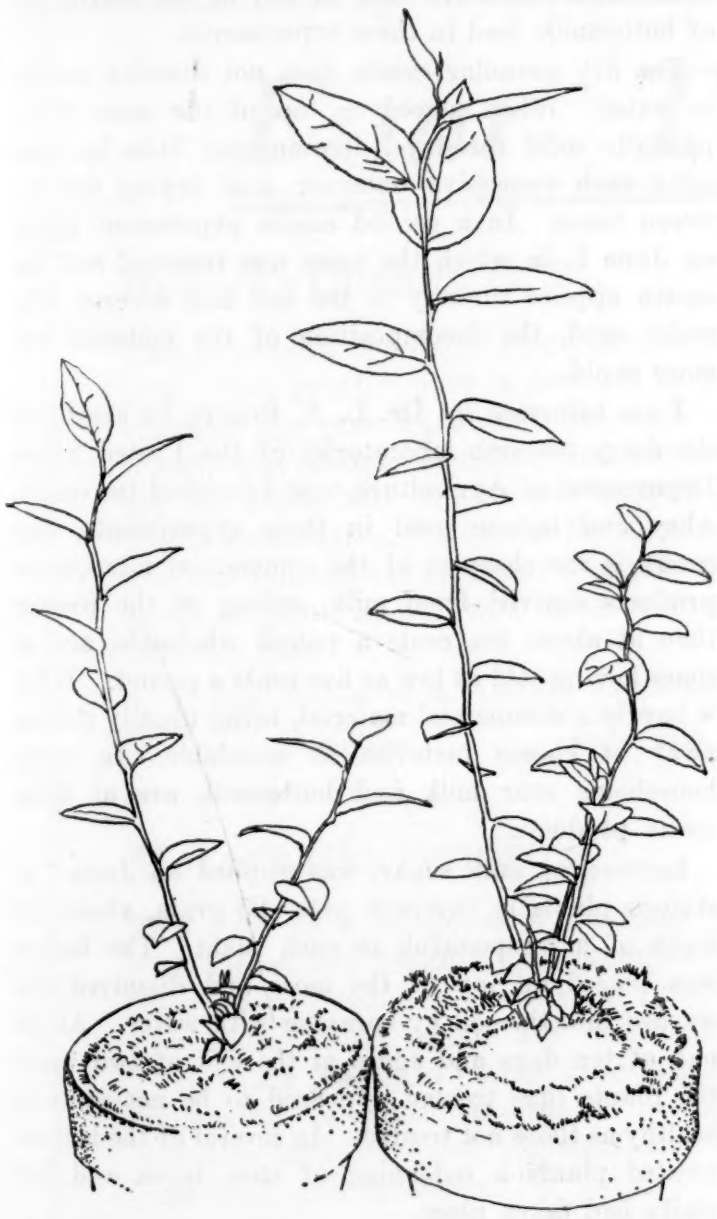

FIGURE 1. Buttermilk as a fertilizer. These two blueberry plants are in the same acid soil, which is well suited to them. The increased growth of the larger plant followed, in four weeks, the application of 5 cc of buttermilk.

The leaves on the new growth of the fertilized plants were conspicuously larger than those on the new growth of the plants not fertilized, and conspicuously larger also than the leaves on the old growth of both lots of plants. The area of the largest individual leaves as well as the total leaf area of the fertilized plants was more than double that of the others. The weighing of two plants, each selected as representing the average in its lot, indicated that the plants fertilized with buttermilk were, at the end of the first month, about three times as heavy as the others.

Another lot of sixteen plants in another flat was treated on the same date, May 14, with half a teaspoonful (about 2.5 cc) of buttermilk to each two-inch pot. These plants went through the same course of stimulated growth as those in the earlier experiment. At the end of the first month the plants treated with buttermilk were 32 per cent. taller than those not treated.

A third experiment, also begun on May 14, concerned the application of a teaspoonful of skimmed sweet milk to each of sixteen blueberry plants in two-inch pots. These plants were stimulated in substantially the same manner as those in the two buttermilk experiments. Indeed in the early days of stimulation the sweet-milk plants appeared to be growing a little more actively than the buttermilk plants. As a probable explanation of this earlier activity it should be stated that when buttermilk is applied to the soil the curd remains on the surface and after decomposition is washed into the soil in the process of watering. When skimmed sweet milk is applied to the soil it penetrates at once, leaving no residue on the surface, and presumably it turns sour within a few hours. The immediate penetration of the sweet milk and its consequent immediate contact with a larger part of the root system of the blueberry are believed to account for the somewhat earlier response of the plant to sweet milk than to buttermilk.

The acid peat-and-sand soil used in raising blueberry seedlings is an excellent medium for the support of acid-soil mosses. During the four months preceding the buttermilk experiments, the surface of the soil in each pot had become covered first with the protonema and later with the leafy plants of a moss which formed a ground cover of close, yellowish-green plush. When buttermilk was applied, the curd, saturated with whey, remained on top of the moss and killed all the moss plants with which it came in contact. The moss that was not killed, however, changed from yellowish-green to bright-green under the stimulating influence of the buttermilk and grew much faster than the moss in the untreated pots. The moss to which the skimmed sweet milk was applied was not injured by contact with the milk, and it took on the same bright-green color and active growth as the moss in the pots fertilized with buttermilk.

When the beneficial action of buttermilk on blueberry plants began to be evident from these experiments, an experiment was begun with azaleas. To each of twelve plants of a new and unnamed variety of kurume azalea, in four-inch pots, was applied a tablespoonful (20 cc) of buttermilk. The plants had been in the pots about five months and the leaves were somewhat yellowish-green. In about two weeks the

azaleas to which the buttermilk had been applied had turned to a dark green color indicative of increased vigor.

No formal experiments were undertaken with buttermilk as a fertilizer for rhododendron seedlings, but to a single healthy bush of *Rhododendron maximum* five feet high and six feet broad, at my house, two quarts of sour milk was applied in May at the time when the leaves on new twigs were expanding. Although there were no similar untreated plants to be used as checks, there is an indication of beneficial effect in the fact that the new leaves grew within a month to a size distinctly larger than the leaves that were produced on the same plant in 1925 and in 1924 without this fertilizer.

To make certain which of the substances contained in milk act as fertilizer, additional experiments were made with these substances separately, namely, whey, casein and lactose (milk sugar).

In the first experiment with whey, begun on June 1, each of sixteen blueberry seedlings in two-inch pots was given a tablespoonful of this liquid, since this happened to be the amount of whey computed to contain the same amount of protein as a teaspoonful of buttermilk. The plants to which a tablespoonful of whey was applied suffered severely during the first five days, and at the end of two weeks they were still in worse condition than untreated plants. The amount of whey applied was so great that it penetrated to all parts of the root system of the plants and in a few cases some of the liquid ran out of the drainage hole in the bottom of the pot. The whey was very acid and it is almost certain that the injury to the plants was caused by this excess of acidity, for in another experiment, begun on June 5, in which half a teaspoonful of whey was applied to each of sixteen two-inch pots, there was no injury, the plants took on a darker green color at the end of a week, and in ten days they were growing more actively than untreated plants.

The experiments with whey have not continued for a sufficiently long period to show whether its fertilizing value is proportional to its nitrogen content, which is about one fourth that of buttermilk.

Whey applied as a fertilizer for blueberries or other acid-soil plants should be diluted with water, probably five to ten parts of water to one of whey. When sour milk or buttermilk that has become exceedingly acid from long fermentation is used as fertilizer it should be similarly diluted.

Casein applied in dry granular form on June 1, .22 gram, the amount in a teaspoonful of buttermilk, to each of sixteen blueberry plants in two-inch pots, began to produce a darker green color in the leaves in eight days. In ten days the casein-treated plants were clearly growing more actively than untreated plants. In two weeks fourteen of the plants had begun to branch or to make new growth from an uppermost dormant bud, both of these activities being evidence of a strong growth impulse not shown in any of the corresponding untreated plants. Up to the present time the experiments indicate that casein is the most active fertilizer of any of the derivatives of buttermilk used in these experiments.

The dry granular casein does not dissolve readily in water. When placed on top of the moss it lay partially solid for days, decomposing little by little after each successive watering, and drying out between times. In a second casein experiment begun on June 1, in which the moss was removed and the casein applied directly to the soil and covered with moist sand, the decomposition of the material was more rapid.

I am informed by Dr. L. A. Rogers, in charge of the dairy research laboratories of the United States Department of Agriculture, who furnished the casein, whey and lactose used in these experiments, that casein is the cheapest of the commercial nitrogenous products derived from milk, selling at the present time at about ten cents a pound wholesale, and at times having sold as low as five cents a pound. Whey is hardly a commercial material, being usually thrown away at cheese factories as unsalable. In many households sour milk and buttermilk are at times waste products.

Lactose, or milk sugar, was applied on June 1 to sixteen plants in two-inch pots, .25 gram, about one tenth of a teaspoonful, to each plant. The lactose was placed on top of the moss and dissolved and washed into the soil by spraying with water. At the end of ten days and again at the end of two weeks the plants thus treated appeared to be not quite so healthy as those not treated. In several of the lactose-treated plants a reddening of stem bases and leaf stalks had taken place.

Thinking that a substance as oily as cream might perhaps be injurious to blueberry plants I applied a teaspoonful of it on May 14 to the soil of each of eight plants in two-inch pots. These plants showed neither injury nor stimulation as a result of the application.

It is clear from these experiments that while skimmed milk, buttermilk, casein and whey are useful as fertilizers for blueberry plants, cream and sugar are not. These are still best utilized, in accordance with established practice, at breakfast, on the blueberries themselves fresh from the icebox.

FREDERICK V. COVILLE

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.